### Title

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### Journal

American journal of preventive medicine, 56(3)

### ISSN

0749-3797



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### Publication Date

2019-03-01

### DOI

10.1016/j.amepre.2018.10.019

Peer reviewed

# Documentation of ENDS Use in the Veterans Affairs Electronic Health Record (2008–2014)

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## INTRODUCTION

The Department of Veterans Affairs (VA) health system is the largest health system in the U.S., and the only system with a nationwide presence, with more than 1,700 healthcare facilities serving 8.7 million veterans per year.[1] Smoking rates among U.S. Veterans are substantially higher than in the general population, with 20.1% of Veterans smoking,[1] compared with 15.5% of the general U.S. population.[2] The VA health system and its associated electronic health record (EHR) provides a unique opportunity in the U.S. context for investigating ENDS documentation practices using clinical data. However, the VA EHR, like other widely used EHR, lacks a structured data field for documenting ENDS use. Typically, ENDS documentation, if it exists at all, is recorded in narrative clinical text, and hence requires the use of text-mining methods to extract relevant data. Apart from two studies focused on ENDS documentation in regional health systems in the U.S.,[3,4] little is currently known regarding the frequency with which clinicians document ENDS use.

This letter reports on work utilizing EHR data derived from a cohort of 20,000 documented smokers in the VA system with the goal of investigating the extent to which ENDS documentation frequency has changed between 2008 and 2014.

## METHODS

The VA Clinical Corporate Data Warehouse was queried to create a nationally representative, randomly sampled cohort of 20,000 patients (8,806,352 clinical notes in total) from Veterans who were documented smokers consistently throughout the years 2008 to 2014. Patients with more than one smoking status class documented in any year (e.g., former smoker, current smoker) were excluded as the primary goal of this study was to understand ENDS documentation changes over time among current smokers. Patient ages in 2008 ranged from 17 to 102 years (mean: 65), with women constituting 5.2% of the sample. To identify ENDS-relevant clinical notes the authors used a list of 14 high precision (i.e., high positive predictive value) keywords (e.g., *e cig*, *e-cig*, *ecig*; Figure 1 provides a complete list) identified and verified in pilot work[5] to perform a keyword search within the patient clinical notes. High precision keywords were used due to ambiguity associated with ENDS-related keywords, such as "vaporizer," which in this data set refers to nicotine use as opposed to marijuana or medical nebulizer use, <20% of the time.[5] Year-on-year (2008–2014) change in frequency of ENDS mentions at the patient level were then determined. The percentage of patients with an ENDS mention was used as the outcome variable ($n$=7, for the 7 years), with year as the predictor variable, and modeled using a generalized linear regression model with log link (log transformation of percentage), family Gaussian, and robust SE to account for time-series autocorrelation.

## RESULTS

A statistically significant increase ($p<0.001$) in the number of patients with at least one documented ENDS mention was observed (0 patients in 2008, 174 patients in 2014, i.e., increasing from 0% to 0.87% of patients). In total, 631 ENDS mentions from 291 unique patients were observed, with the greatest year-on-year increase in patients occurring between 2013 and 2014 (Figure 1). Interestingly, the percentage of patients with an ENDS mention increased exponentially, doubling each year from the previous year (1.95-fold increase per year, 95% CI=1.76, 2.15, $p<0.001$).

## DISCUSSION

Analysis of the VA EHR dataset revealed that — consistent with results reported using EHR data derived from a large regional health system[3] — the number of VA patients with ENDS mentions increased in frequency significantly over time, with 0 patients in 2008 and 174 patients in 2014. This result indicates that clinicians are increasingly likely to document their ENDS-related discussions with patients who smoke. However, there remains a striking discrepancy between the frequency of patients with ENDS use documentation in the VA EHR (0.87% of patients in 2014) and the much greater prevalence—estimated to be 11.5%[6] (10.4% in smokers aged 45–64 years, and 8.3% in smokers aged 65 years and older)—of ENDS use among U.S. smokers generally, suggesting that ENDS use is currently massively under-documented by clinicians in the VA system, and that there is an acute

need for the inclusion of an ENDS-related structured data field in the VA EHR.

## ACKNOWLEDGMENTS

The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs or the U.S. government. This study was approved by the University of Utah's IRB (IRB 00088382).

MC conceptualized the study and wrote the first draft. DM conducted the analysis and contributed substantially towards writing the first draft. BS performed the initial data pull and contributed substantially towards writing the first draft. WC and OP provided expertise on working with Veterans Affairs clinical notes and contributed to the first draft. GS provided statistical support. SZ provided expertise in the broad area of ENDS use and its relationship to tobacco use. All authors contributed to the writing and approved the final version of the manuscript.

No financial disclosures were reported by the authors of this paper.

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# LIST OF FIGURES

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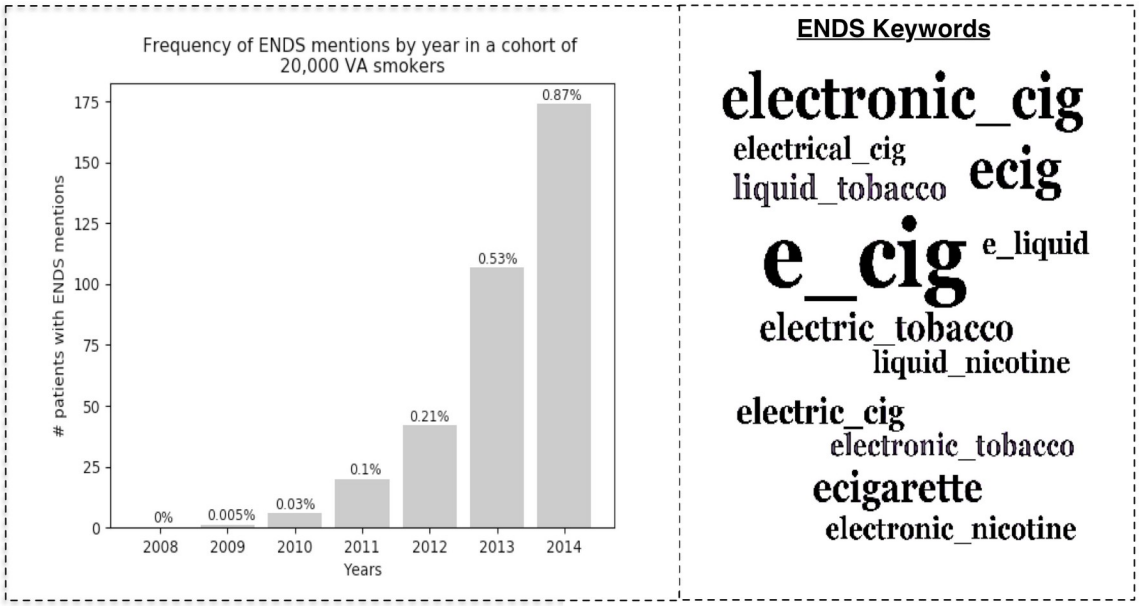
Frequency of ENDS mentions by year in a cohort of 20,000 VA smokers
# patients with ENDS mentions
Years
0%
0.005%
0.03%
0.1%
0.21%
0.53%
0.87%
2008
2009
2010
2011
2012
2013
2014
ENDS Keywords
electronic_cig
electrical_cig
liquid_tobacco
ecig
e_cig
e_liquid
electric_tobacco
liquid_nicotine
electric_cig
electronic_tobacco
ecigarette
electronic_nicotine